

Applicants: INOUE et al.
Serial No.: 09/473,988

Docket No.: 991493
Group Art Unit: 2814

REMARKS

Claims 1-9 and 20 are pending. Applicants propose amendment of claims 1, 2 and 7-9 for further clarity. Since the amendments do not raise new issues, entry thereof after final rejection is earnestly solicited. A marked-up version showing the proposed amendment is attached hereto as "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Claims 1-5, 7-9 and 20 were rejected under 35 USC § 103(a) as being unpatentable over Shields. In addition, claim 6 was rejected under 35 USC § 103(a) as being unpatentable over Shields in view of Yu. These rejections are respectfully traversed.

Claim 1 is directed to a semiconductor device comprising (with reference to Fig. 1H):

a conductive film corresponding to the conductive film 1 of Fig. 1H;

a first insulating film, corresponding to the HSQ film 12;

a second insulating film, corresponding CVD silicon oxide film 13 (13a-13f), and

a third insulating film, corresponding to the CVD silicon oxynitride film 11.

In contrast thereto, Fig. 5 of Shields provides a conductive film, corresponding to metal feature 51;

a first insulating film, corresponding to HSQ layer 52;

a second insulating film, corresponding to the dielectric layer 53 (although it is a single layer). However, Shields does not provide any element which would correspond to a third insulating film.

The Examiner's remarks include "...has been formed to cover the conductive film or the lower interconnection layer with a third insulating layer 53 being interposed therebetween" and

that "although Fig. 5 does not depict a second insulating layer formed on the first insulating layer, Shields teaches forming additional interconnection multi-layers. Thus, a second insulating layer is formed on the first insulating layer." From these statements, it appears that the Examiner does not understand the present invention described in claim 1 and the structure illustrated in Fig. 5 of Shields. Accordingly, applicants propose amendment of the claims so that the structure of claim 1 can be more easily understood.

It is also the Examiner's position that a multilayer structure consisting of layers of the same material would be equivalent to a single layer. However, the function and effect of the multilayer structure of the present invention is discussed in detail on page 13, line 8 through page 14, line 4. From this discussion, it is clear that the claimed structure does not function in the same manner as a single layer. The multilayer structure more reliably suppresses line defects apt to be generated in the upper CVD oxide film owing to water vapor from the HSQ film. Even if many line defects have been developed, the line defects do not expand or extend, and can be suppressed within the respective layers of the multilayer structure. Thus, a multilayer structure clearly is not equivalent to a single layer structure as asserted by the Examiner.

Furthermore, a second insulating layer would not be formed on the first insulating layer even if Shields forms additional interconnect multi-layers. If one of ordinary skill in the art would desire to form additional interconnect multi-layers on the structure of Fig. 5, then the insulating film 52 would simply be formed at an increased thickness in the same manner that the insulating film 53 was formed. Accordingly, one of ordinary skill in the art would not form a second insulating film on the first insulating film 52 of Shields as asserted by the Examiner.

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The second insulating layer simply is not a single insulating layer formed on a first insulating layer, but is the main feature of the invention including the effect as discussed above. Each layer constituting the second insulating layer is formed separately from the other layers after the appropriate interval.

For at least the foregoing reasons, the claimed invention distinguishes over the cited art and defines patentable subject matter. Favorable reconsideration is earnestly solicited.

Should the Examiner deem that any further action by Applicants would be desirable to place the application in better condition for allowance, the Examiner is encouraged to telephone Applicants' undersigned attorney.

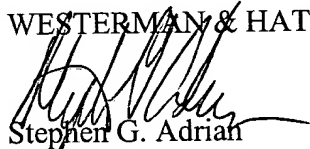
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In the event that this paper is not timely filed, applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

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Attachment: Version with markings to show changes made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE
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IN THE CLAIMS:

Claims 1, 2 and 7-9 have been amended as follows:

1. (Four Times Amended) A semiconductor device comprising an insulating interlayer formed on a conductive film [and], said insulating interlayer including:

a first insulating layer of a composition containing SiH[,]; [and]

a second insulating layer formed on said first insulating layer[,]; and

a third insulating layer formed between said conductive film and said first insulating layer,

wherein said first insulating layer has an H content of not less than 15.4 atom% in the composition, and has been formed to cover said conductive film [with a third insulating layer being interposed therebetween], and

said second insulating layer has a multilayer structure made up from layers of the same material.

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2. (Three Times Amended) A semiconductor device comprising an insulating interlayer formed on a conductive film, said insulating interlayer [and] including:

- a first insulating layer of a composition containing SiH[,]; and
- a second insulating layer formed on said first insulating layer,

wherein a threshold at which a degassing amount from said first insulating layer abruptly decreases upon a slight increase in the SiH content exists in the relation between said SiH content of said first insulating layer and said degassing amount from said first insulating layer,

said first insulating layer has a SiH content not less than said threshold, and

said second insulating layer has a multilayer structure made up from layers of the same material.

7. (Three Times Amended) A semiconductor device comprising a semiconductor element formed on a semiconductor substrate, and a multilayered interconnection structure formed over said semiconductor element and electrically connected to said semiconductor element,

wherein said multilayered interconnection structure is an interconnection structure of at least two layers in which a conductive film or a lower interconnection layer and an upper interconnection layer formed on an insulating interlayer are electrically connected through a contact hole formed in said insulating interlayer,

said insulating interlayer includes:

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a first insulating layer of a composition containing SiH₄; and
a second insulating layer formed on said first insulating layer,
a threshold at which a degassing amount from said first insulating layer abruptly
decreases upon a slight increase in the SiH content exists in the relation between said SiH content
of said first insulating layer and said degassing amount from said first insulating layer,
said first insulating layer has a SiH content not less than said threshold, and
said second insulating layer has a multilayer structure made up from layers of the same
material.

8. (Five Times Amended) A semiconductor device comprising a semiconductor element
formed on a semiconductor substrate, and a multilayer interconnection structure formed over
said semiconductor element and electrically connected to said semiconductor element,

wherein said multilayered interconnection structure is an interconnection structure of at
least two layers in which a conductive film or a lower interconnection layer and an upper
interconnection layer formed on an insulating interlayer are electrically connected through a
contact hole formed in said insulating interlayer,

said insulating interlayer includes:

a first insulating layer of a composition containing SiH₄; and

a second insulating layer formed on said first insulating layer₄; and

a third insulating layer formed between said conductive film and said first insulating
layer.

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said first insulating layer has an H content of not less than 15.4 atom% in the composition, and has been formed to cover said conductive film or the lower interconnection layer with a third insulating layer being interposed therebetween, and

said second insulating layer has a multilayer structure made up from layers of the same material.

9. (Three Times Amended) [A] An insulating interlayer formed on a conductive film [and including] comprising:

a first insulating layer of a composition containing SiH₄; and

a second insulating layer formed on said first insulating layer,

wherein a threshold at which a degassing amount from said first insulating layer abruptly decreases upon a slight increase in the SiH content exists in the relation between said SiH content of said first insulating layer and said degassing amount from said first insulating layer,

said first insulating layer has a SiH content not less than said threshold, and

said second insulating layer has a multilayer structure made up from layers of the same material.

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(D) wherein said first insulating layer has an H content of not less than 15.4 atom% in the composition, and has been formed to cover said conductive film, and

said second insulating layer has a multilayer structure made up from layers of the same material.

2. (Three Times Amended) A semiconductor device comprising an insulating interlayer formed on a conductive film, said insulating interlayer including:

a first insulating layer of a composition containing SiH; and

a second insulating layer formed on said first insulating layer,

wherein a threshold at which a degassing amount from said first insulating layer abruptly decreases upon a slight increase in the SiH content exists in the relation between said SiH content of said first insulating layer and said degassing amount from said first insulating layer,

said first insulating layer has a SiH content not less than said threshold, and

said second insulating layer has a multilayer structure made up from layers of the same material.

Da 7. (Three Times Amended) A semiconductor device comprising a semiconductor element formed on a semiconductor substrate, and a multilayered interconnection structure formed over said semiconductor element and electrically connected to said semiconductor element,

wherein said multilayered interconnection structure is an interconnection structure of at least two layers in which a conductive film or a lower interconnection layer and an upper interconnection

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layer formed on an insulating interlayer are electrically connected through a contact hole formed in said insulating interlayer,

said insulating interlayer includes:

a first insulating layer of a composition containing SiH; and

a second insulating layer formed on said first insulating layer,

a threshold at which a degassing amount from said first insulating layer abruptly decreases upon a slight increase in the SiH content exists in the relation between said SiH content of said first insulating layer and said degassing amount from said first insulating layer,

said first insulating layer has a SiH content not less than said threshold, and

said second insulating layer has a multilayer structure made up from layers of the same material.

8. (Four Times Amended) A semiconductor device comprising a semiconductor element formed on a semiconductor substrate, and a multilayer interconnection structure formed over said semiconductor element and electrically connected to said semiconductor element,

wherein said multilayered interconnection structure is an interconnection structure of at least two layers in which a conductive film or a lower interconnection layer and an upper interconnection layer formed on an insulating interlayer are electrically connected through a contact hole formed in said insulating interlayer,

said insulating interlayer includes:

a first insulating layer of a composition containing SiH; and

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Amended 7
a second insulating layer formed on said first insulating layer; and
a third insulating layer formed between said conductive film and said first insulating layer,
said first insulating layer has an H content of not less than 15.4 atom% in the composition,
and has been formed to cover said conductive film or the lower interconnection layer with a third
insulating layer being interposed therebetween, and
said second insulating layer has a multilayer structure made up from layers of the same
material.

9. (Three Times Amended) An insulating interlayer formed on a conductive film
comprising:

a first insulating layer of a composition containing SiH; and
a second insulating layer formed on said first insulating layer,
wherein a threshold at which a degassing amount from said first insulating layer abruptly
decreases upon a slight increase in the SiH content exists in the relation between said SiH content
of said first insulating layer and said degassing amount from said first insulating layer,
said first insulating layer has a SiH content not less than said threshold, and
said second insulating layer has a multilayer structure made up from layers of the same
material.
